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Devonian Tentaculitids from North-West Australia

By Kathleen Sherrard*

Abstract: Tentaculitids from the Napier, Virgin Hills and Pillara Formations and the Sadler Limestone in the Devonian in the Canning Basin of North-West Australia are described, figured and classified. They show affinities with tentaculitids from Middle and Upper Givetian, Middle, Upper Middle and Upper Frasnian strata in the USSR and Czechoslovakia.

Tentaculites, Dicricoconus, Uniconus, Multiconus and *Homoctenus* are represented. For the most part, the zones indicated by the tentaculitid species supplement correlations already made by other workers using conodonts and ammonoids in the same rocks.

INTRODUCTION

The presence of tentaculitids in Silurian and Devonian rocks has been recorded in palaeontological literature for over a century but it was not until recently that their value as index fossils was appreciated. G. P. Ljaschenko (1959, 1965) after having studied tentaculitids occurring in the USSR, was able to demonstrate their potentiality as zone markers. Similar work has been done by Bouček in Czechoslovakia (1964), Zagora in East Germany (1962, 1964) and Lardeux in Western Europe and North Africa (1969).

In New South Wales I described tentaculitids from Silurian and Devonian rocks and compiled a table of their occurrences (1967). Therefore the opportunity offered me by Mr. W. Cowan of the West Australian Petroleum Pty. Ltd. to study tentaculitids from Middle and Upper Devonian limestones along the northern margin of the Canning Basin of West Australia was most welcome. The Canning Basin, formerly called the Desert Artesian Basin, in the West Kimberley, extends from the coast between about 17°S and 20°S in a south-easterly direction almost to the 128°meridian.

Some of the limestones in this Basin have been dated and correlated in terms of standard Devonian zones (Glenister & Klapper 1966, Seddon 1970) by means of ammonoids and conodonts. Tentaculitids in these limestones can therefore be dated, but some of the best preserved tentaculitids occur in rocks at localities BC 83-11 and BC 83-12 where reliable dating by ammonoids and conodonts has not been possible and Mr. Cowan has informed me that inferences as to their age can be drawn only from their field relations and accompanying macrofossils. Further, it should be pointed out that the ages of some samples of tentaculitids differ from those suggested by accompanying conodonts and ammonoids.

Tentaculitids are by no means abundant in the material that I have received, and since their calcareous shells occur in an unsilicified limestone it has been impossible to free them from their matrix. In rare samples whole fossils are exposed on fractured rock surfaces (Pl. 11, fig. 1) but most of the study has had to be carried out on polished rock surfaces, photographs, thin sections and peels.

The table, p. 181, shows the distribution according to age of tentaculitids described.

As the table shows, *Tentaculites, Dicricoconus, Uniconus, Multiconus* and *Homoctenus* have been recognized in the collection. They can be compared with, or show affinities with, species set up by G. Ljaschenko, and have been named accordingly.

The majority of tentaculitids discussed here are from localities within 8 km of Bugle Gap, between Emanuel and Lawford Ranges, situated about 126°E, 18°40′S in the Northern Canning Basin of West Australia and about 80 km south-east of Fitzroy Crossing. Others were obtained near Menyous Gap through Pillara Range, 40 km north-west of Bugle Gap. A third collection is from Windjana Gorge, through Napier Range, over 200 km north-west of Bugle Gap.

I wish to acknowledge with gratitude the kindness of Dr. George Thomas of the School of

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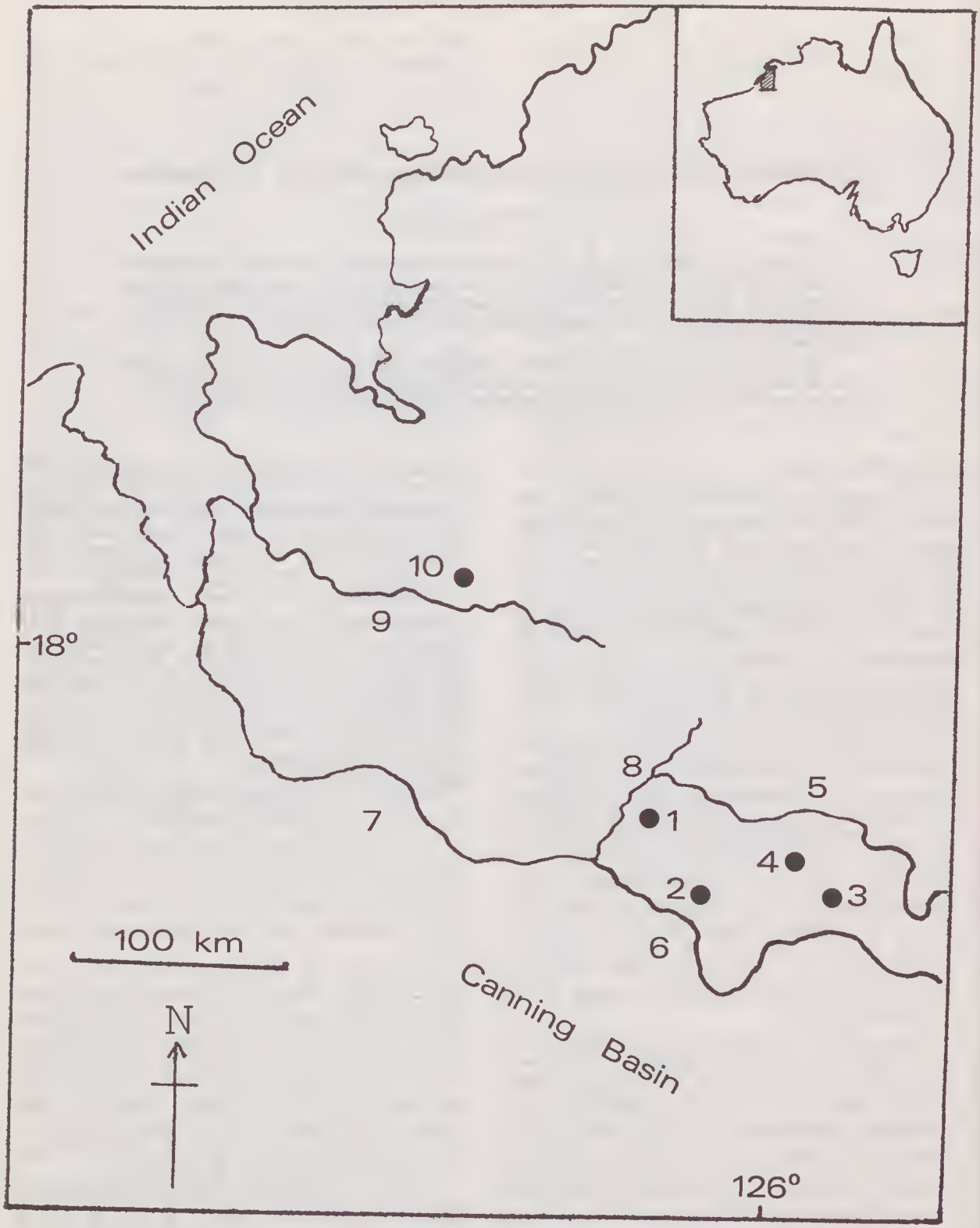

FIG. 1—Locality map for tentaculitid occurrences in the Northern Canning Basin, North-West Australia. Numbers on sketch-map indicate the following: 1, Pillara Range and Menyous Gap (Localities BC 45, BC 46). 2. Emanuel Range and Prices Creek (Locality BC 21). 3. Lawford Range (Localities BC 83, BC 85). 4. Bugle Gap (Locality BC 23). 5. Margaret River. 6. Christmas Creek. 7. Fitzroy River. 8. Fitzroy Crossing. 9. Lennard River. 10. Windjana Gorge and Napier Range (Localities BC 7, BC 127).

DISTRIBUTION, ACCORDING TO AGE, OF TENTACULITIDS DESCRIBED.

DEVONIAN	Frasnian	Upper	*Uniconus* aff. *livnensis*
		Middle	*Tentaculites* aff. *donensis* *Uniconus* aff. *kremsi* *Multiconus* cf. *schimanskii* *Dicricoconus* aff. *lanciformis* *Homoctenus* aff. *krestovnikovi*
		Lower	
	Givetian	Upper	*Dicricoconus* aff. *tagangaevi*
		Middle	*Tentaculites* aff. *maslovi* *Dicricoconus* aff. *mesodevonicus*

Geology, University of Melbourne who is responsible for the photographs used in Pl. 11, figs. 1 & 3, and of Dr. R. McTavish of West Australian Petroleum Pty. Ltd. for his helpful advice on the manuscript of this paper.

SYSTEMATIC DESCRIPTIONS

Class CONICONCHIA G. Ljaschenko 1955

Order TENTACULITIDA G. Ljaschenko 1955

Family TENTACULITIDAE Walcott 1886

This family is represented by two genera, *Tentaculites* Schlotheim 1820 and *Dicricoconus* Fisher 1962.

Genus **Tentaculites** Schlotheim 1820

The apical part of the narrowly conical shells of this genus is covered with fine, transverse, equal-sized annulations. These are succeeded towards the aperture of the shell by coarser annulations each separated by fine riblets.

Tentaculitids showing affinity with two species of this genus have been identified from the Canning Basin. One form is *T.* aff. *maslovi* G. Ljaschenko and the other is *T.* aff. *donensis* G. Ljaschenko. *T.* aff. *maslovi* occurs at localities BC 83-11 and BC 83-12 in the Sadler Limestone and at localities BC 85-6 and BC 85-7 in the Pillara Formation at outcrops on the west flank of the Lawford Range, east of Bugle Gap.

T. aff. *donensis* is found as small fragments in limestone from near the Lennard River about 200 km north-west of Lawford Range at locality BC 127-6, in the Napier Formation, and also about 30 km to the south at locality BC 108-11, and at locality BC 113-2 on the Napier Range 15 km north of the Lennard River. It has also been recognized at locality BC 49-4 20 km NNE. of Fitzroy Crossing.

Tentaculites aff. maslovi G. Ljaschenko 1957

(Pl. 11, figs. 3, 4)

1957 *Tentaculites maslovi* G. Ljaschenko, p. 220, Pl. III, figs. 8-12.

1959 *Tentaculites maslovi* G. Ljaschenko, p. 77, Pl. IV, figs. 1-5.

Specimens of *Tentaculites* aff. *maslovi* in this collection attain a length of 8 mm and an apertural diameter of 0·5 mm with an apical diameter of 0·2 mm. The apical part of the shell is covered with small annulations four of which occur in the width of the diameter of that part. Annulations coarser than these are seen near the shell's aperture. They are of two sizes, each of the coarser being separated by 4-5 smaller annulations. In the width of the aperture, four coarse annulations (both sizes) occur. In the whole length of the shell, the rounded interstices are one and a half times as wide as the annulations. The internal surface of the shell is smooth in the apical region but follows the annulations near the aperture. Three or four partitions cross the internal chamber near the apex.

T. maslovi is recorded from the Middle Givetian

Tentaculites aff. maslovi G. Ljaschenko

	BC 83-12(4)	BC 85-7 M	BC 83-12 VL2	BC 85-7 HK
Length in mm	7·0	3·8 (apical section)	5 (apical section)	4·5+
Diameter aperture	0·5	0·35	0·4	0·45
tip	0·2	0·1	0·1	0·15
Total annulations	65	50	72	50
Annulations in size of apertural diameter apically	3 4	4	4	5-6
Annulations in 1 mm	11	17	9	9-14
Interstices: Annulations	3:2	2:1	1:1	2:1
Angle of growth	3°	6°	3°	
Internal surface	All apically smooth, aperturally ringed			

by G. Ljaschenko (1959), so that the occurrence of *T.* aff. *maslovi* in localities BC 83-11 and BC 83-12, BC 85-6 and BC 85-7 indicates this age for the rocks in these localities. BC 83-11 and BC 83-12 have not been dated by conodonts by Seddon (1970, p. 748), but Mr. W. Cowan informed me in a letter that localities BC 85-6 and BC 85-7 'are possibly Givetian'.

MATERIAL: 20 specimens.

Tentalculites aff. **donensis** G. Ljaschenko 1959

(Pl. 11, fig. 2)

1959 *Tentaculites donensis* G. Ljaschenko, p. 80, Pl. III, figs. 1, 2.

This species occurs as small fragments of shells (up to 3·5 mm long) at locality BC 127-6 in limestone in Windjana Gorge, about 200 km north-west of Lawford Range, and at other localities indicated earlier. Vertical sections through fragments show sharply pointed large annulations separated by three or four much smaller ones. There are two to three annulations in 1·2 mm which is the size of the diameter at the apertural edge of the shells. The interstices between the smaller annulations are rounded and two to three times wider than the annulations. The internal surface of the shell usually reflects the annulations of the external surface. This species indicates an Upper-Middle Frasnian age. The conodont evidence indicates the stage of *to* Iβ/γ —*to* Iγ which is consistent with the evidence from the tentaculites.

MATERIAL: 8 specimens (fragmentary).

Genus **Dicricoconus** Fisher 1962

Tentaculitids with comparatively large conical shells and transverse annulations of two sizes indicating that they belong to the genus *Dicricoconus* have been identified in the collection. Three species have been found: *D.* aff. *mesodevonicus* (G. Ljaschenko), *D.* aff. *tagangaevi* (G. Ljaschenko) and *D.* aff. *lanciformis* (G. Ljaschenko).

Dicricoconus aff. **mesodevonicus**

(G. Ljaschenko 1954)

(Pl. 11, figs. 5, 6; Pl. 12, fig. 7)

1954 *Tentaculites mesodevonicus* G. Ljaschenko, p. 32, Pl. VII, figs. 1-3.
1959 *Heteroctenus mesodevonicus* G. Ljaschenko, p. 86, Pl. VI, figs. 1-4.
1962 *Dicricoconus mesodevonicus* (G. Ljaschenko), Fisher, Treatise W 114, fig. 58(3).
1969 *Dicricoconus mesodevonicus* (G. Ljaschenko), Lardeux, listed pp. 7, 59.

In shells showing affinity with this species, small annulations occur for about one-third their length from the apex and are followed by a few coarse annulations occurring singly, each of which is separated by up to twelve smaller ones. Thin rings occur on the aperturally facing surfaces of some coarse annulations (Pl. 11, figs. 5, 6; Pl. 12, fig. 7). This character and the occurrence of a large number of small annulations between each big one, suggest that these shells are closer to *D. mesodevonicus* than to *D. tagangaevi*, which is also recorded as a Givetian species (Ljaschenko 1959). The total number of coarse annulations is smaller than is quoted in the diagnosis of *D. mesodevonicus* and is closer to that for *D. tagangaevi*. The sharp-edged annulations which also suggest *D. tagangaevi* are seen in specimens from locality BC 85-6, but on the other hand the alternation of wider with narrower annulations in 'absolutely rhythmical order' noted by Bouček (1964, p. 27) as a character of *D. mesodevonicus* is seen in specimens from localities BC 83-11 and BC 85-6 (Pl. 11, fig. 6) in the Sadler Limestone and Pillara Formation. The affinity with *D. mesodevonicus* seems the greater.

MATERIAL: 50 specimens.

Dicricoconus aff. **tagangaevi**

(G. Ljaschenko 1959)

(Pl. 13, fig. 13)

1959 *Heteroctenus tagangaevi* G. Ljaschenko, p. 85, Pl. VII, figs. 1-4.

Dicricoconus aff. **mesodevonicus** (G. Ljaschenko)

	BC 83-11	BC 85-7(4)	BC 19-1	BC 85-6	BC 85-7 (cor)
Length (mm)	7·8	9	10	8+	6·5+
Diameter aperture	0·55	0·65	0·75	0·65	0·65
tip		0·1		0·35 (above tip)	
Total annulations	60	50		50	52
Annulations in size of apertural diameter	5	3	3	2	4
Annulations in 1 mm	8	5	3	3	6
Interstices: Annulations	5:2	2:1		3:2	2:1
Angle of growth	2°	4°			
Internal Surface	Smooth			Repeats external surface	Smooth

1969 *Dicricoconus tagangaevi* (G. Ljaschenko), Lardeux, listed p. 59.

The conical shells of tentaculitids in the collection which show affinity with this species are incomplete, the longest fragment being 3·5 mm with 25 annulations. In the fragments, solitary large annulations are followed by a series of smaller ones which are arranged in a series of diminishing sizes in a direction away from the apex until the next large one is reached. Such a gradual diminution in size of the small annulations is characteristic of the species *tagangaevi*. Near the apex width of shell is 0·55 mm (measured from extreme tip of an annulation to extreme tip on other side). In this length near the apex 4 annulations occur. At the apertural end of fragments width of shell is 0·8 mm (also measured from tip to tip of the largest annulations). Seven annulations occur in this length in this part of the shell. Eight occur in 1 mm. All annulations are shaped like a bird's beak. The size of the rounded interstices between the annulations also gradually decreases. The internal surface of the wall is smooth. The angle of slope of the walls is 4°.

D. tagangaevi is recorded by G. Ljaschenko (1959) from the top of the Givetian. In the Canning Basin the tentaculitids showing affinity with *D. tagangaevi* occur, though very rarely, in the ? Pillara Limestone at locality BC 40-1 east of Cave Spring in Bugle Gap and nearby at locality BC 86-2, and in the Sadler Limestone at Menyous Gap in the Pillara Range, at localities BC 45-13 and BC 45-14. Dr. McTavish tells me the condonts from there suggest the zone of *Polygnathus asymmetrica* (bottom of Upper Devonian, Glenister & Klapper 1966).

MATERIAL: 8 specimens.

Dicricoconus aff. lanciformis
(G. Ljaschenko 1959)
(Pl. 12, fig. 8)

1959 *Heteroctenus lanciformis* G. Ljaschenko, p. 89, Pl. VIII, figs. 1-3.

1969 *Dicricoconus lanciformis* (G. Ljaschenko), Lardeux, listed p. 59.

Shells, showing affinity with this species are found incomplete, as oblique sections measuring up to 3 mm long and from 0·6 to 0·8 mm in apertural diameter. Up to 20 annulations of two sizes can be counted. They are of a blunted triangular shape and are separated by shallow semi-circular interstices twice to three times the width of the annulations. The larger annulations are about three times as big as each of the seven or more annulations between them. The smaller annulations vary very little in size among themselves. The internal surface of the wall is smooth. Four annulations occur in the size of the apertural diameter (0·8 mm).

D. aff. *lanciformis* is accompanied by *Homoctenus* aff. *krestovnikovi* at Prices Creek on the north side of Emanuel Range at localities BC 21-5, BC 21-8 and BC 21-14, and at localities BC 83-15 and BC 93-16 in the Lawford Range east of Bugle Gap. The occurrences of these tentaculties of Middle Frasnian age (Ljaschenko 1959) endorses information given me by Mr. Cowan that localities BC 83-15 and BC 83-16 may contain fossils younger than at BC 83-11 and BC 83-12 which contain tentaculitids from the Middle Givetian.

MATERIAL: 10 specimens.

Family HOMOCTENIDAE G. Ljaschenko 1955
Genus **Homoctenus** G. Ljaschenko 1955
Homoctenus aff. krestovnikovi
G. Ljaschenko 1957
(Pl. 12, figs. 9, 10)

1957 *Tentaculites krestovnikovi* G. Ljaschenko, p. 94, Pl. 1, figs. 1-4.

1959 *Homoctenus krestovnikovi* G. Ljaschenko, p. 102, Pl. XX, figs. 1-3.

Only one species of one genus belonging to this family has been recognized in the collection. Tentaculitids referred to it show an affinity with *H. krestovnikovi* or possibly *H. tokmovensis*. They are very small, sharply pointed cones whose dimensions are given in the accompanying table. A longitudinal section (Pl. 12, fig. 10) shows annulations meeting in sharp projections, between which the rounded interstices increase in size towards the cone's aperture. The internal surface of the thin wall repeats the ringed pattern of the external wall. There is in some specimens a suggestion of the stepped appearance characteristic of the neighbouring genus, *Polycylindrites*, but an allocation to *Homoctenus* is considered more satisfactory.

Homoctenus aff. *krestovnikovi* has been collected at locality 23-1(a2) on the east side of Bugle Gap. Conodonts from this locality have been dated as *to* Iγ which is approximately co-eval with the Middle Frasnian. Tentaculitids from localities BC 21-5, BC 21-8, BC 22-6, BC 22-13 and BC 38-2, west of

Homoctenus aff. krestovnikovi G. Ljaschenko

	BC 23-1(a2)	BC 23-1(a2)	BC 23-1(a2)	BC 21-8	BC 21-8	BC 21-8	BC 21-5b
Length (mm)	3	4	2	5+	2	2	2·3
Diameter aperture	0·4	0·35	0·35	0·55	0·2	0·25	0·45
tip	0·2	0·2			0·1	0·075	0·1
Total annulations	50	70	40	50	53	40	30
Annulations in size of diameter	3		6	5 (aper.) 3 (tip)	4	10 (aper.) 5 (tip)	5
Angle of growth		8°	5°	7°	6°	4°	10°

Uniconus aff. livnensis G. Ljaschenko

	BC 7-4	BC 7-4	BC 7-4
Length (mm)	5·4	4	2
Diameter (mm) aperture	0·4	0·75	0·75
Total annulations	65	25+	
Annulations in size of diameter	4 (aper.)		
	5 (tip)	4	
Angle of growth	5°		
Internal surface	Smooth		

Bugle Gap and BC 128-8 near the Lennard River have also been identified as *Homoctenus* aff. *krestovnikovi* although Mr. Cowan sent me the information that their dating from field relations and accompanying macrofossils is 'probably to Iα,' that is, older. No conodont dating has been given me for locality BC 21, BC 22 nor BC 128.

MATERIAL: 10 specimens.

Sub-Family UNICONINAE G. Ljaschenko 1955

This sub-family is represented by two genera, *Uniconus* G. Ljaschenko 1955 and *Multiconus* G. Ljaschenko 1955. Tentaculitids showing affinity with two species of *Uniconus* and one of *Multiconus* have been identified.

Uniconus aff. livnensis G. Ljaschenko 1959

(Pl. 13, figs. 15, 16)

1959 *Uniconus livnensis* G. Ljaschenko, p. 112, Pl. XVI, figs. 1-3.

These tentaculitids whose dimensions are given in an accompanying table, have straight narrowly conical shells on which external surfaces show nearly identical annulations separated by rather deep triangularly shaped interstices twice as wide as the annulations. The annulations are sharply inclined towards the aperture of the shell. The internal surface of the thick wall is smooth. The wall is pierced by radial canals.

U. aff. *livnensis* has been found at Locality BC 7-4 in the Napier Formation in the Windjana Gorge which the Lennard River has cut through the Napier Range.

U. livnensis is placed by Ljaschenko in the uppermost zone of the Upper Frasnian and is the youngest tentaculite described by her (1959, 1965). Conodonts dated *to* Iδ—post *to* Iδ, that is uppermost Frasnian to basal Famennian, also occur at locality BC 7-4. Conodonts and tentaculites, therefore, suggest a similar age.

MATERIAL: 5 specimens.

Uniconus aff. kremsi G. Ljaschenko 1959

(Pl. 13, fig. 14)

1959 *Uniconus kremsi* G. Ljaschenko, p. 111, Pl. XVII, figs. 1-4.

Tentaculitids showing an affinity to this species occur as incomplete conical shells up to 4·5 mm long and between 0·5 and 0·65 mm in apertural diameter. There are up to 30 annulations on the shells. All annulations are of a similar almost equilateral triangular shape, 3 or 4 of them occurring in a length equal to the apertural diameter of the shell. The annulations are separated by rounded interstices twice as wide as they are. The internal surface of the shell is smooth.

This species has been recognized in dark-pink limestone from localities BC 113-2 on Napier Range, BC 127-3 and BC 127-6 in the Windjana Gorge in the Napier Formation. *Tentaculites* aff. *donensis* also occurs at these localities. Both it and *U.* aff. *kremsi* indicate an Upper-Middle Frasnian age. Conodont dating is *to* Iβ/γ—*to* Iγ.

MATERIAL: 12 specimens.

Uniconus aff. kremsi G. Ljaschenko

	BC 127-3	BC 127-3	BC 127-3	BC 127-6	BC 127-6	BC 127-6	BC 127-6
Length (mm)	3	1·8	2·2	4·5	3	2·5	4
Diameter (mm) aperture	0·7	0·45	0·5	0·6	0·65	0·45	0·5
tip				0·2		0·35	0·3
Total annulations	14	22	20	30	12	18	40
Annulations in size of diameter (apertural)	4	5	4	4		3	3
Annulations in 1 mm				8		8	8
Angle of growth						3°	3°
Internal surface	All smooth						

Multiconus cf. **schimanskii**
G. Ljaschenko 1957
(Pl. 12, fig. 11; Pl. 13, fig. 12)

1957 *Tentaculites schimanskii* G. Ljaschenko, p. 95, Pl. I, fig. 5; Pl. II, figs. 4-6.

1959 *Multiconus schimanskii* G. Ljaschenko, p. 114, Pl. XVII, figs. 5-8.

A tentaculitid quite distinct from others in the collection occurs at locality BC 21-9, west of Bugle Gap. A longitudinal section shows annulations with sharp angular tips which are of varying sizes. They are arranged in three successive series which rest on top of one another. Each series has annulations which gradually increase in size and then suddenly decrease to a much smaller size and then increase again. The largest annulations project from the wall by 0·3 mm and are followed by annulations of gradually diminishing diameter for a distance of 1·5 mm until the smallest is reached. The smallest annulation projects less than 0·1 mm approximately, and is succeeded immediately by an annulation projecting 0·2 mm from the wall. This is followed by another series of annulations in which each annulation projects by a diminishing amount until a third series of larger annulations is reached. The wall is thick but its internal surface is not entirely smooth, because its internal surface sometimes repeats the external surface. The length of the incomplete shell is 4·5 mm and its apertural diameter is 0·75 mm. The sharp angular annulations are separated by rounded interstices one and a half times as wide as the annulations. There are four large annulations in the size of the apertural diameter, but in the same space seven small ones occur. The total number of annulations in the incomplete tentaculitid is 32.

MATERIAL: 1 specimen.

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EXPLANATION OF PLATES 11-13

PLATE 11

FIG. 1—Tentaculitid, Loc. BC 83-12, West of Lawford Range. × 20.

FIG. 2—*Tentaculites* aff. *donensis* G. Ljaschenko. Loc. BC 127-6, Lennard River. × 50.

FIG. 3—*Tentaculites* aff. *maslovi* G. Ljaschenko. Loc. BC 83-12, West of Lawford Range. × 10.

FIG. 4—*Ibid.* × 55.

FIG. 5—*Dicricoconus* aff. *mesodevonicus* (G. Ljaschenko). Loc. BC 83-11, West of Lawford Range. × 50.

FIG. 6—*Ibid.* Loc. BC 85-7, West of Lawford Range, showing thin annulations on larger ones. × 50.

PLATE 12

FIG. 7—*Dicricoconus* aff. *mesodevonicus* (G. Ljaschenko). Loc. BC 19-1, NE. of Emanuel Range. × 50.

FIG. 8—*Dicricoconus* aff. *lanciformis* (G. Ljaschenko). Loc. BC 21-5, Lloyd Hill, Prices Creek. × 50.

FIG. 9—*Homoctenus* aff. *krestovnikovi* G. Ljaschenko. Loc. BC 21-8, Lloyd Hill, Prices Creek. × 50.

FIG. 10—*Ibid.* Loc. BC 23-1, East of Bugle Gap. × 50.

FIG. 11—*Multiconus* cf. *schimanskii* G. Ljaschenko. Loc. BC 21-9, Lloyd Hill, Prices Creek. × 5.

PLATE 13

FIG. 12—*Multiconus* cf. *schimanskii* G. Ljaschenko. Loc. BC 21-9, Lloyd Hill, Prices Creek. × 40.

FIG. 13—*Dicricoconus* aff. *tagangaevi* (G. Ljaschenko). Loc. BC 45-14, NE. Menyous Gap, Pillara Range. × 50.

FIG. 14—*Uniconus* aff. *kremsi* G. Ljaschenko. Loc. BC 127-6, Lennard River. × 30 (about).

FIG. 15—*Uniconus* aff. *livnensis* G. Ljaschenko. Loc. BC 7-4, Windjana Gorge. × 20 (about).

FIG. 16—*Ibid.* × 65 (about).